Local Food Systems in Cambodia, Myanmar, and the Philippines: Perspective from the Local Communities

Working Paper No. 356

CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

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RESEARCH PROGRAM ON Climate Change, Agriculture and Food Security

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Abstract

Food systems must provide adequate, healthy, and sustainable diets to the growing and changing population whilst responding to shocks and stressors related to climate variability, urbanization, globalization, conflicts, and economic change. This study examined the national food systems of Cambodia, Myanmar, and the Philippines and the local food systems of complementary Climate-Smart Villages: Chhouk, Htee Pu, and Himbubulo Weste.

Among several food system drivers, climate change is the external stressor perceived strongly in agricultural communities and as shown by the data on national climate variability. Income and gender inequality, political instability, and socioeconomic circumstances undermine multi-level interventions to deliver necessary food system outcomes.

While national policies to achieve an equitable and resilient food system are critical, local-level initiatives such as implementing climate-smart agriculture strategies, recognizing landlessness issues, and addressing fragmented market infrastructure are vital for the local food systems to thrive and deliver on health, economic and environmental goals. This could also guide in establishing standards, collective goals, and policy formulation directions for robust national food systems.

Keywords

Food system; agriculture; climate change; climate-smart agriculture; climate-smart villages

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Acronyms

CSA	climate-smart agriculture
CSV	Climate-Smart Village
FAO	Food and Agriculture Organization
FGD	Focus group discussion
GBD	Global Burden of Disease
GDP	Gross Domestic Product
GHG	Greenhouse gas
HLPE	High-Level Panel of Experts Report on Nutrition and Food Systems
KII	Key informant interview
PPP	purchasing power parity

Introduction

Myanmar, Cambodia, and the Philippines are low-income countries in Southeast Asia dealing with a high number of challenges, including globalization, urbanization, conflict and political instability, and demographic changes. Furthermore, COVID-19 continues to be a significant public health threat in these countries, together with migration, economic decline, and health system collapse. Meanwhile, income disparities and gender inequality persist as significant issues, turning these countries into climatically hostile territories. Increasing incidence of drought, rainfall variability, stronger typhoons, land degradation, and biodiversity loss are among the climate-related threats that are becoming more evident over the past years. These challenges, if unaddressed, would drive the population further into poverty, undernourishment, and malnutrition.

Agriculture is an essential sector in Cambodia, Myanmar, and the Philippines and contributes significantly to economic development and national food security. Whilst agricultural productivity has improved over the past years, food producers, especially the smallholder farmers, are challenged with limited economic access to input supply and inefficient distribution infrastructure. Millions of the population, mainly in the agriculture sector, are trapped in poverty. Nearly a third of the countries' population suffers from undernourishment and are severely food insecure. Over the past decades, the prevalence of stunting and wasting among children under-5 have remained public health problems in these countries while the prevalence of overweight and obesity in all age groups (children under-5, children and adolescents 5-19 years old and adults) and diet-related diseases among adults have been on the rise.

Given the many challenges confronting these countries, the food systems must transform to respond to various shocks and stressors while delivering on economic and environmental objectives and food and nutrition security.

Food systems are multidimensional and comprise all the actors, activities and processes involved in feeding the population. They encompass growing, harvesting, processing, packaging, distributing, selling, buying, preparing, consuming, and disposing of food and food-related items. Multiple actors in the food systems interact and manage these linked

activities within the food environment and are influenced by food system drivers to influence the population's diets and determine outcomes.

Like any other countries, the food systems of Cambodia, Myanmar and the Philippines are complex, interrelated, and function in a continuum with inevitable trade-offs. Within each country are diverse and interconnected food systems and are distinguished by geographic and administrative boundaries.

Using the food systems lens, this report explores the national food systems of Cambodia, Myanmar, and the Philippines. It has adapted the food systems conceptual framework presented by the High-Level Panel of Experts (HLPE) on Food Security and Nutrition (2017), which describes the contributions of food supply chains, food environments, consumer behaviour, and individual factors to various outcomes (nutrition, health, economic, social and environment), drivers and impact.

The report also aims to describe the local food systems of Chhouk Village in Cambodia, Htee Pu Village in Myanmar, and Himbubulo Weste Village in the Philippines, all of which are built as Climate-Smart Villages (CSVs). CSVs are platforms for climate change adaptation and venue for testing, developing, and subsequently scaling up location-specific strategies for addressing climate risks and challenges. The work highlights the local food system's activities where the different actors such as farmers, retailers, distributors and middle persons, farming households, and daily wage earners are primarily engaged. The hotspots or challenges that the actors identified serve as the entry point to discuss how climate-smart agriculture (CSA) programming contributes to developing sustainable food systems.

The International Institute of Rural Reconstruction (IIRR), together with local partners, supports CSVs in the three countries as platforms to scale up and out the CSA strategy. CSA is anchored on three pillars that address food security and climate challenges together, namely 1) agriculture that sustainably increases productivity and incomes, 2) adaptation by managing responses and building resilience to climate variability, and 3) mitigation by reducing or removing greenhouse gas emissions from agricultural activities (FAO, 2010).

Food system assessment

This work uses the definition of the food system, as it "gathers all the elements (environment, people, inputs, processes, infrastructures, and institutions, among others) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the output of these activities, including socio-economic and environmental outcomes." (HLPE, 2014).

Figure 1 shows the food systems' components, drivers, and elements that interact with one another. The food systems have seven main drivers: climate and the environment, globalization and trade, income growth and distribution, urbanization, population growth and migration, politics and leadership, and sociocultural context. The food system consists of four core constituent elements: food supply chains, food environment, individual factors, and consumer behavior. How the components interact amongst each other and how they respond to food system drivers shape the population's diets and determine the food system outcomes: nutrition and health, economic, social, and environment (HLPE, 2017).

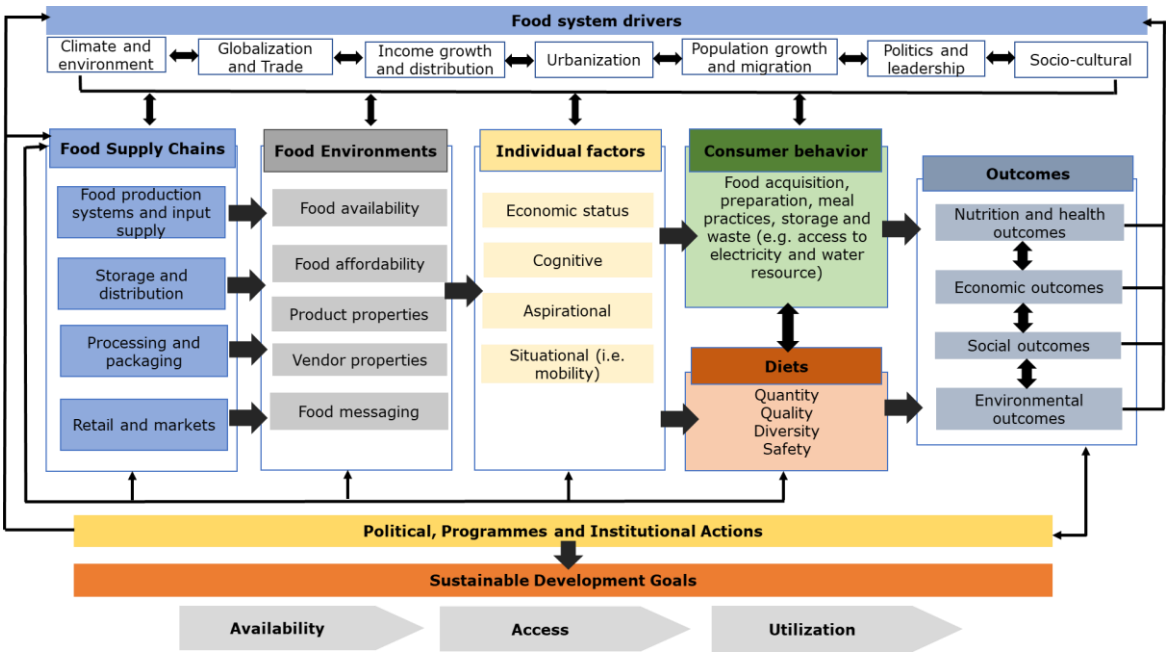

Figure 1. Conceptual framework of food systems for diets and nutrition Source: adapted from HLPE 2017.

The food system study employed secondary data analysis and qualitative interviews. Desk review was performed at national and sub-national levels involving the CSVs, and was guided

by two primary references for the national and sub-national level indicators: 1) the Food Systems Dashboard, which is available online and collates more than 170 indicators that describe country-level food system drivers, components and outcomes (Food Systems Dashboard, 2020); and 2) Compendium of Indicators for Food System Assessment, which provides additional indicators that the authors found helpful for the food system study (Kennedy et al., 2020). The same set of indicators guided the profiling of the food system at the village level.

Key informant interviews (KII) and focus group discussions (FGD) were conducted to capture insights and data relevant to the local food system. The interview guides' development was based on the same indicators from the food system framework and secondary data collection. The study utilized the pre-tested KII and FGD interview guide translated into local languages. Data collection was held between September 2020 and November 2020. Due to the COVID-19 pandemic, the consultation was held virtually between the regional and the local teams. Trained tertiary-level enumerators conducted face-to-face interviews following the local COVID-19 health protocol. A smaller number of respondents than the regular number participated in each FGD session.

On average, FGD and KII lasted for 45 minutes to 90 minutes and were recorded with the participants' permission. The research team obtained informed consent and information sheet from all research participants. Local researchers transcribed and encoded the recording, then translated it into English using Microsoft Excel. Thematic analysis based on interview responses and literature review was conducted along with descriptive analysis when necessary.

Respondents of the KII were stakeholders from the local government units and official or representative of relevant offices or groups involved in food system operations. Twenty respondents were interviewed per village. Four FGDs were conducted in each village for 1) individuals involved in food production in the area; 2) individuals involved in storage, processing, distribution and retail, waste and recovery; 3) farming households; and 4) non-farming households or daily wage earners. A total of 96 respondents in Chhouk Village, Cambodia, 60 respondents in Htee Pu Village, Myanmar, and 95 respondents in Himbubulo Weste, Philippines, participated in the FGDs.

Table 1. Participants in the qualitative interviews for the local food system assessment

		Chhouk Village	Htee Pu Village	Himbubulo Weste Village
Key Informant Interview				
Individuals in authority or knowledgeable about the local food system	n	20	20	20
	Mean age (years)	49.9	51.0	52.9
	Sex (Male/Female)	11/9	17/3	14/6
Focus Group Discussions				
1. Individuals involved in food production in the area	n	23	15	24
	Mean age (years)	46.6	48.0	43.7
	Sex (Male/Female)	6/17	12/3	8/16
2. Individuals involved in storage, processing, distribution and retail, and waste and recovery	n	22	15	24
	Mean age (years)	37.4	45	43.9
	Sex (Male/Female)	11/11	3/12	6/18
3. Farming households	n	26	15	23
	Mean age (years)	44.4	54.1	49.6
	Sex (Male/Female)	5/21	15/0	19/4
4. Non-farming households or daily wage earners	n	25	15	24
	Mean age (years)	40.5	51.4	43.1
	Sex (Male/Female)	3/22	8/7	10/14

PART 1. Country-level food system

The Food Systems Dashboard classifies food systems as rural and traditional, informal and expanding, emerging and diversifying, modernizing and formalizing, and industrialized and consolidated. The classification resembles the 2017 HLPE food system typology that considers agricultural productivity, urbanization, dietary energy in the food supply, food affordability, and food-based dietary guidelines (HLPE 2017). For Food Systems Dashboard,

specific typology indicators were collated and analyzed using data-driven methods to reflect the different components of the food system. The four typology indicators were agriculture value added per worker, the share of dietary energy from staples, the number of supermarkets per 100,000 population and per cent urban population of the total population.

Table 2. The classification of food systems based on the Food System Dashboard

	Cambodia	Myanmar	Philippines
Agricultural value added per worker, constant 2010 $	$1,444 (2019)	$1,698 (2017)	$3,320 (2019)
Share of dietary energy from staples	69% (2016)	49% (2016)	58% (2016)
Number of supermarkets per 100,000 population	508 (2018)	404 (2018)	2,054 (2018)
Percent of total population living in urban areas	23% (2019)	30% (2019)	47% (2019)

Based on the above indicators, Cambodia has a rural and traditional food system, while Myanmar and the Philippines are operating in informal and expanding food system typology. Table 3 further illustrates the components of each food system.

Table 3. Characteristics of food system typology of Cambodia, Myanmar and Philippines

	Rural and traditional food system	**Informal and expanding food system**
	Cambodia	**Myanmar and Philippines**
Food production	Agricultural productivity is low, with production typically focused on staple crops. Farming is mainly done by smallholders.	Agricultural productivity is higher than in rural and traditional food systems, with greater use of inputs such as seeds and fertilizer. Medium- and some large-scale farms are beginning to emerge.
Storage and distribution	Supply chains are short due to smaller urban populations, resulting in many local, fragmented markets. Higher losses due to inadequate storage and distribution infrastructure.	Establishment of modern food supply chains and centralized distribution centers. Distribution infrastructure remains weak with absence or limited cold chains and poor market access.
Retail and markets	Food is mainly sold in informal market outlets, including independently-owned small shops, street vendors, and local public markets. Supermarkets and fast food are beginning to grow in number	Informal market outlets remain to be the major sources of food especially for fresh produce such as fruits, vegetables, and animal source foods. Supermarkets and fast food are rapidly expanding and becoming more accessible.

	but mainly seen in more developed localities	
Food environment (availability and affordability)	Starchy staples are highly available; the quantity, diversity and prices of foods available are season-dependent. Processed and package foods start to emerge in retail stores.	Starchy staples are highly available; as well as fresh produce such as fruits, vegetables, and animal source foods; affordability varies across income groups. Processed and packaged foods are available and affordable in urban and rural areas, and the demand continues to increase; Demand for convenience foods increases as the formal labor force grows.
Diets	Diet consists largely of staple grains, roots and tubers, legumes, and some seasonal fruits and vegetables, with less access to animal-sourced foods.	Diet consists largely of staple grains, roots and tubers, legumes, and some seasonal fruits and vegetables, and increasing demand for animal-sourced foods, processed and convenience foods

1.1 Food system drivers

1.1.1 Climate change and environment

Annual surface temperature and precipitation patterns are fundamental measurements to describe climate and determine the landscape-suitable crops and livestock. Changes in surface temperature and precipitation can disrupt various activities in the food production system. Between the three countries, Myanmar has encountered extreme climate variations over the past years.

Based on the 25-year data (1991 to 2016) on rainfall, the three countries recorded high precipitation variability. The coefficient of variation, a measure of the precipitation variability, was highest in Myanmar (0.97) and Cambodia (0.84), then lower in the Philippines (0.47) (World Bank 2019a). The amount and frequency of rainfall have a gripping impact on agriculture as this affects the amount of available water for household use, irrigation, and industry.

The average surface temperature has risen rapidly over the decades in the three countries. In 2019, Cambodia and the Philippines had an annual average change in surface temperature thrice the rate recorded in 1990 while in Myanmar, it was eight times the rate (FAO 2019a).

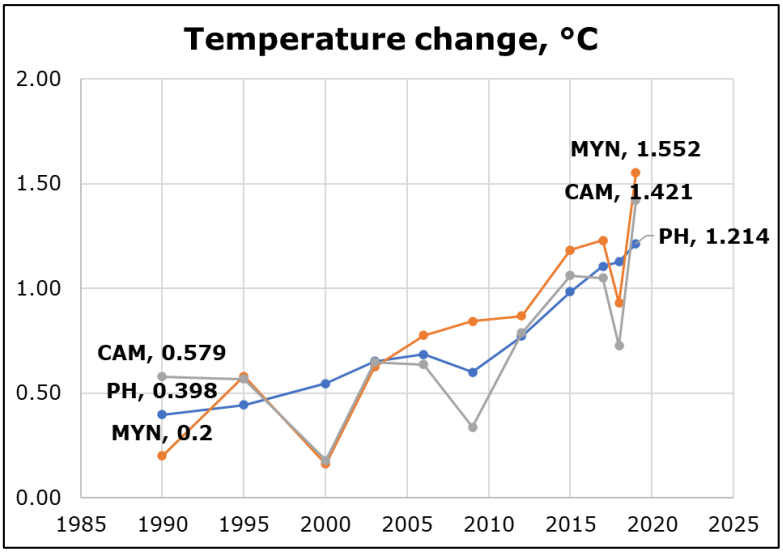

Figure 2. Annual surface temperature change (Source: FAO 2019a)

Greenhouse gas (GHG) emissions from agriculture (rice cultivation, enteric fermentation, manure and synthetic fertilizers), land-use change, and forestry contribute primarily to climate change. Notably, GHG emissions from agriculture in the three countries are lower than in other territories of similar income and food system typology.

Table 4. Greenhouse gas (GHG) emissions from agriculture

Country	GHG emissions from agriculture
Cambodia	21.7 $MtCO_2e$
Myanmar	82 $MtCO_2e$
Philippines	62.2 $MtCO_2e$
Low-middle-income countries	367 $MtCO_2e$
Rural and traditional food systems	440 $MtCO_2e$
Informal and expanding food systems	79 $MtCO_2e$

Source: (Food Systems Dashboard 2020); (World Resources Institute 2021)

The two potential sources of GHG emissions in agriculture-based economies are synthetic fertilizer and manure and rice paddy management. Remarkably, all three countries contribute to lower rice methane emissions than the average of countries with similar income and food system typology. However, Myanmar has significantly higher GHG emissions from fertilizer usage. Fertilizers may enhance crop production, but over-application of synthetic fertilizer emits GHGs, particularly nitrous oxide, degrading soil quality.

Table 5. Emissions from fertilizer usage and rice cultivation

	Fertilizer emissions Mg CO_2e k $kcal^{-1}$ yr^{-1}	Rice methane emissions Mg CO_2e M $kcal^{-1}$ yr^{-1}
Cambodia	63.48	6.36
Myanmar	501.56	23.2
Philippines	2.25	19.50
Low-middle-income countries	25.49	133.7
Rural and traditional food systems	3.90	152.8
Informal and expanding food systems	3.60	38.12

Source: (Food Systems Dashboard 2020)

Rice is an important staple crop in these countries. While rice methane emission is significantly lower than the average for countries of the same income and food system typology, Figure 3 suggests that it is the primary source of emissions by sector in the three rice-producing economies. Based on the average emissions by sector (1990-2018), rice cultivation is the primary contributor to emissions in Cambodia (46.1%), Myanmar (38.6%), and the Philippines (61.3%) (FAO 2019b).

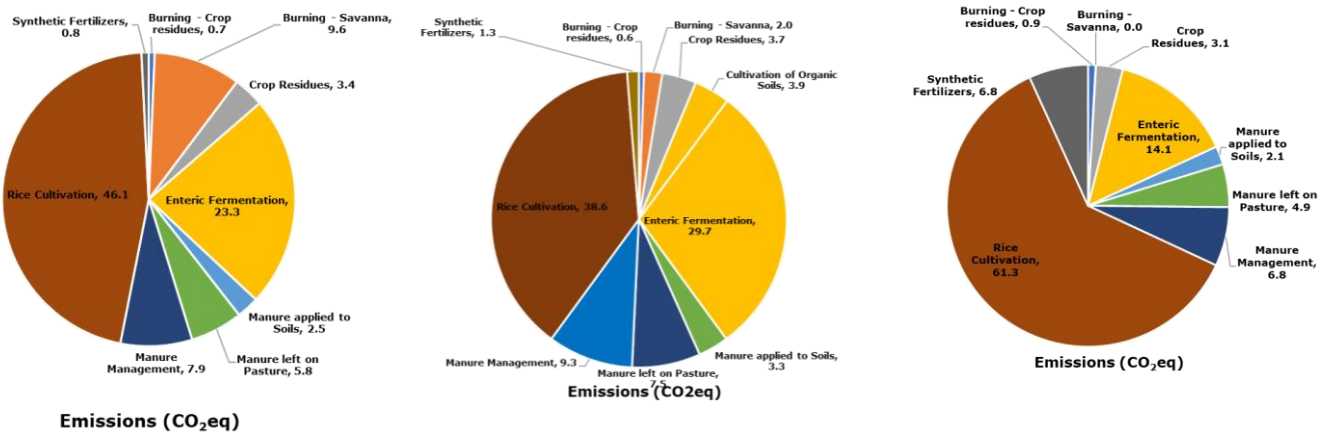

Figure 3. Emissions by sector (FAO 2019b)

Cambodia, Myanmar, and the Philippines are climatically hostile territories and highly vulnerable to climate risks because of stronger typhoons and more pronounced incidences of drought over the past years. On the other hand, GHG emissions from the agri-food production systems of these countries are lower than the average of countries of similar income and food system typology, and their combined contribution to the global emissions is relatively small. The unique biophysical environment and prevailing climate-related issues

of each country would drive national climate adaptation strategies. While doing so, mitigation strategies should also be part of the national agenda to respond to global action to lower GHG emissions from agriculture.

1.1.2 Income growth and distribution

Cambodia, Myanmar, and the Philippines are low middle-income economies with a Gross National Income (GNI) per capita between $1,026 and $3,995. The annual growth in GNI per capita in 2017 of Cambodia was at $5.3, 2011 PPP (purchasing power parity), which is comparable to Myanmar ($5.7, 2011 PPP), and the Philippines ($4.9, 2011 PPP) (World Bank 2019b). The values are based on US dollars at PPP exchange rates in 2011.

GNI reflects the country's income from domestic and overseas sources and tracks the country's wealth on a year to year basis. However, for countries like Cambodia, Myanmar and the Philippines that depend mainly on informal sectors and subsistence activities, the value may be underestimated and does not account income distribution inequalities.

The population living in poverty or with income of less than $1.90 (2011 PPP) a day has declined from 6.2% (2015) to 2.0% (2017) in Myanmar and from 13.9% (2000) to 6.1% (2015) in the Philippines (World Bank 2019b). The reduction suggests fewer households experiencing food insecurity and malnutrition, given that poverty significantly influences accessibility, affordability and consumption of food.

Meanwhile, income inequality measured in the Gini index remains high in Myanmar (38.1, 2015) and the Philippines (44.4, 2015) (World Bank 2019c). Income gap among individuals or households can influence access to food, services and opportunities, and activities in the food system.

1.1.3 Globalization and trade

Globalization and trade as food system drivers demonstrate the country's economy, domestic production, and resilience to an economic shock. The continuous growth of the country's Gross Domestic Product (GDP) since 2000 indicates economic progress. GDP measures the total market value of all domestic finished goods and services within a country in a set period. In 2019, the Philippines showed a more robust economic condition and growth rate than Cambodia and Myanmar (Table 6).

Trade, which influences the volume of domestic production, the proportion of imports and exports, and the other food system sectors, is most important in Cambodia, as indicated by its high trade-to-GDP ratio (124.9%) in 2018. Small countries need international trade of goods and services to satisfy domestic demand.

Table 6. Gross Domestic Product and trade

	Cambodia	Myanmar	Philippines
Gross Domestic Product, $ 2011 PP	4,388	5,142	8,908
Trade-to-GDP, %	124.9%	48.0%	76.1%

Source: (FAO 2020); (World Bank 2019d)

The negative cereal imports dependency ratio of Cambodia and Myanmar show restrictive trade policies and can be correlated with the food system's vulnerability to variations in domestic supply and to economic shocks that could potentially put them at higher risk of widespread shortages of staple grains during climate disasters such as floods or droughts. The Philippines, on the other hand, have a relatively high cereal import dependency which suggests the low capacity for domestic supply and high vulnerability to international prices, especially in rural areas.

The cereal import dependency ratio expresses the ratio of cereal imports to total cereal supply (cereal production, import and export) and measures the cereal self-sufficiency of a country and the reliance on cereal imports. These are important considerations for the national policy decisions on imports and food prices.

Table 7. Cereal import dependency ratio (3-year average)

	Cambodia	Myanmar	Philippines
2004-2006	1.8	-1.5	21.7
2009-2011	-1.3	-3.1	21.6
2014-2016	-8.7	-0.6	18.6
2015-2017	-9.7	-1.3	20.4

Source: FAO 2020

1.1.4 Socio-cultural context

The adult literacy rate in the three countries is high, which suggests that most individuals aged 15 and above can both read and write and can understand a short, simple statement about their everyday life. Meanwhile, the low gender inequality index (Scale 0 - 100, 0 represents perfect equality, an index of 100 implies perfect inequality) suggests that strong

disparity between females and males exists in terms of access to reproductive health, empowerment, and the labour market.

Both lack and uneven access to education and gender inequality undermine economic development and, consequently, affect doing businesses that create job opportunities and using human potential in the food system.

Table 8. Adult literacy rate and gender inequality index

	Cambodia	Myanmar	Philippines
Adult literacy rate	80.5% (2015)	75% (2016)	98.2% (2015)
Gender inequality index	0.47	0.46	0.43

Source: (World Bank 2019e); (UNDP 2020)

1.1.5 Politics and leadership

The countries' development is challenged by apparent political volatility and general threat to freedom of expression and free media, which negatively impact policy formulation and program implementation to sustain equitable and robust national food systems.

Overall, the three countries scored weak in political stability and absence of violence/terrorism index (Table 9). The indicator, political stability and absence of violence, measures "perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism" (World Bank 2019f).

Similarly, the perceived ability to vote, freedom of expression, and free media are weak in these three countries (Table 9). Another indicator, voice and accountability, measures "perceptions of the extent to which a country's citizens can participate in selecting their government, as well as freedom of expression, freedom of association, and a free media" (World Bank 2019f).

These two indicators influence how policies and programs are enacted and implemented in the countries, especially those related to agricultural production, trade and importation, provisions of essential services, and other related programs related to the food systems.

Table 9. Politics and leadership-related measures

	Cambodia	Myanmar	Philippines
Political stability and absence of violence/terrorism index	0.11	-1.31	-1.12
Voice and accountability index	-1.22	-0.89	0.04

Source: World Bank 2019f

1.1.6 Population growth and urbanization

The annual population growth rate is 1.5% in Cambodia and the Philippines and 0.6% in Myanmar. (World Bank 2019g). Over the past years, these countries have experienced gradual yet continuous population growth, which in the longer term could pressure the national food system to increase food supply to meet the increasing demand.

The increase in the population living in urban settings is also becoming a concern for these agricultural economies. The transition would result in longer food supply chains, a fewer workforce in the rural agricultural areas, and more workforce required in the agriculture sector to meet the needs in rural and urban areas. Also, urbanization drives dietary shifts as food high in salt, sugar, and sodium becomes available and accessible. The Philippines has the highest urban population at 47%, followed by Myanmar (30%) and Cambodia (23%) (World Bank 2019h).

1.2. Food Supply Chains

1.2.1 Production systems and input supply

Agri-food production systems and input supply represent the primary production of foods and related inputs such as crops, livestock and fisheries.

The three countries encounter an increase in agricultural productivity over the years, which could translate to improvement in farmers' livelihood and greater access to agricultural inputs, including but not limited to quality seeds, fertilizer, and irrigation system. The Philippines' 3-year agriculture value added per worker, a measure of agricultural productivity value added per unit of input for agriculture sectors, is higher than Cambodia and Myanmar (Table 10).

Small farm holdings continue to contribute mainly to the national food supply, with 2.0 hectares as the average agricultural holding size. However, while irrigation is an essential agricultural input, the percentage of cultivated land equipped with irrigation remains lower for Cambodia, Myanmar and the Philippines than the weighted average for low-middle income countries (31%). Between the three countries, fertilizer consumption in the Philippines is significantly higher than the average of countries with the same informal and expanding typology (178 kg per ha of arable land) and the same income classification (124 kg per ha of arable land). Fertilizer utilization in Cambodia and Myanmar is relatively low.

Except for the Philippines, agriculture employs near the same proportion of male and females. Moreover, available data for Myanmar and the Philippines suggest a decline in the proportion of people employed in agriculture, indicating lesser opportunities in the agriculture sector or shifting of the workforce to non-agricultural jobs. On the other hand, Myanmar has the most significant share of employment dedicated to agriculture.

Table 10. Input supply of three countries

	Cambodia	Myanmar	Philippines
Agriculture value added per worker (Constant 2010, $)	1,444 (2019)	1,698 (2017)	3,320 (2019)
Average size of agricultural holding (ha), 2000	No data	2.0	2.0
Percentage of cultivated area equipped for irrigation (%), 2013-17	6.6	16.8	17.3
Fertilizer usage (kg per ha of arable land)	17.4	17.9	157.4
Share of employment in agriculture (%)	19.7 (Male) 22.5 (Female) 20.8 (Total) 2012	32.3 (Male) 32.9 (Female) 32.6 (Total) 2019	15.5 (Male) 5.8 (Female) 11.9 (Total) 2019
		51.0 (Total) 2017	24.3% (Total 2018

Source: World Bank, 2019i; FSD 2020; FAO 2021a; World Bank 2019j; FAO 2021b

These countries' agricultural productivity has increased over the past years, as shown by improved national cereal yield (including maize, millet, rice, sorghum, wheat, barley, oats, rye, among other grains) since 2000 (Figure 4). Likewise, the production of animal-sourced products in the form of flesh meat has also improved specifically in Myanmar and the

Philippines. An increase in cereal yields indicates improvement and greater access to agricultural inputs and service. As agricultural countries, this also suggests economic development.

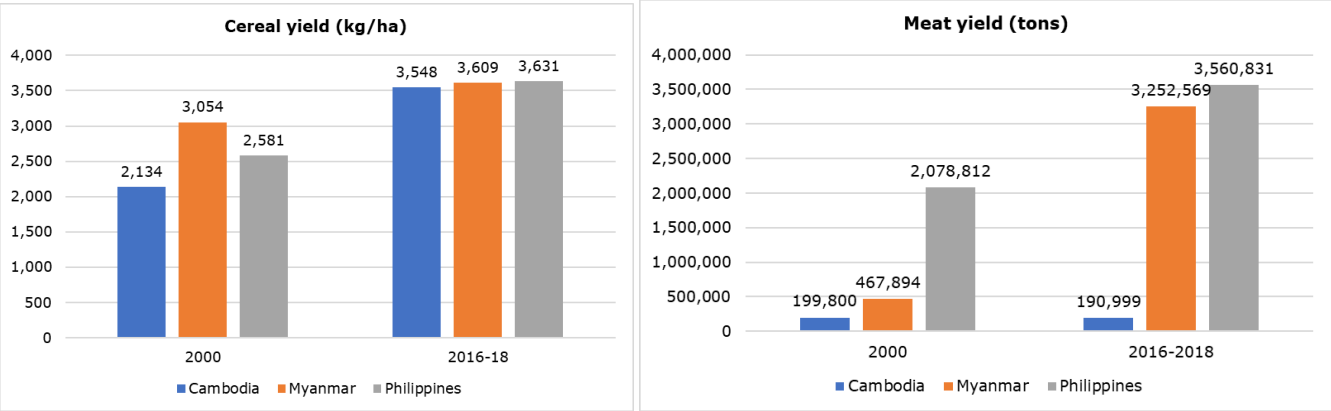

Figure 4. Cereal and meat yield (FAO 2021c; FAO 2021d)

1.2.2 Storage and distribution

The agricultural infrastructure index is a "composite indicator that measures the distribution, transport and storage capacity based on an assessment of a country's road, port, air transport, rail, and irrigation infrastructure, as well as investment in crop storage facilities" (Food Systems Dashboard 2020).

Using this index, the three countries scored poorly and even scored lower than the weighted average score for low-middle income countries (41, 2018). Infrastructure provision extends the agricultural development potential for countries. Investments in rural infrastructure would reduce transportation costs and improve the farmers' access to markets, resulting in substantial agricultural growth and expansion.

In terms of road connectivity, Myanmar has higher coverage in national road density per square kilometer of land area, including highways, primary roads, secondary roads, tertiary roads, and local roads, between Cambodia and the Philippines (Table 11), and that of rural and traditional (0.9 km/sq km) and informal and expanding (0.8 km/sq km) (Food Systems Dashboard 2020). A substantial amount of agricultural produce is lost between the farm and consumers due to poor road network and inappropriate storage facilities, which adversely reduce the income of farmers and the available supply in the national food environment.

Meanwhile, access to electricity is important in the food system as proper processing, preservation, and storage of food commodities are dependent on the use of electricity. The Philippines has high coverage of the rural population with access to electricity, at 90% in 2017 (Table 11). This indicates that most of the population may have access to means for cold storage to avoid or reduce food losses and improve food quality, from production to consumption. On the production side, farmers may be encouraged to produce more and diversify production to other perishable food commodities.

Table 11. Storage and distribution infrastructure

	Cambodia	Myanmar	Philippines
Agricultural infrastructure index (score 0-100, 100 is best)	31.4	32.7	32.3
National road density (kilometre per square kilometre of land area)	0.15	5.11	0.16
Rural population with access to electricity, %	86	60	90

Source: Food Systems Dashboard 2020; World Bank 2018a

Conversely, the inadequate storage and distribution facilities and fragmented food supply chains are reflected in significant domestic supply losses for key food commodities (Table 12). The 3-year average (2015-2017) of cereal losses in Cambodia is at 14.1%, which is significantly higher than the weighted average for low-middle income countries (5.5%) and countries with rural and traditional food system (6.0%) (Food Systems Dashboard 2020). Losses are the "quantity of crops that are lost during storage, distribution, and processing but not including retail and quantities lost at the household as part of consumption" (FAO 2021e).

Table 12. Losses as a per cent of domestic supply

	Food losses, 3-year average (2015-2017), %			
	Cereal	Pulses	Fruit	Vegetable
Cambodia	14.1	4.8	8.0	11.0
Myanmar	5.5	5.4	7.6	9.5
Philippines	0.8	2.1	11.2	5.1
Low-middle-income countries	5.5	4.9	13.0	13.0
Rural and traditional food system	6.0	4.2	14.0	14.0
Informal and expanding food system	5.2	6.7	12.0	9.1

Source: FAO 2021e; Food Systems Dashboard 2020

1.2.3 Processing and packaging

Agricultural industries generate income and employment and contribute to the overall economic development of countries by processing and converting raw agricultural materials into value-added products. These industries are crucial, with about 32.3% value share of food, beverage, and tobacco sub-sectors being added to the manufacturing sector's total value. Its share is low for Myanmar (5.3%) and Cambodia (6.6%) and even lower compared to the weighted average of lower-middle-income countries (15%) and countries with the same food system typology (11%). The agricultural industries in these countries are vital in the broader manufacturing sector, which is still in the early stages of growth. Activities like food processing and trading provide alternative livelihood and off-farm employment opportunities (World Bank 2018b; Food Systems Dashboard 2020).

Moreover, the Philippines has a mandatory legislation to fortify common food commodities such as rice, salt, wheat flour, and oil. Conversely, Cambodia and Myanmar have mandatory and voluntary legislation to fortify salt, respectively (Food Systems Dashboard 2020).

1.3. Food environment

1.3.1 Food availability

The Shannon Diversity Index, a measure of how varied food items (crops and livestock) are in a country and how evenly they are distributed, determines the diversity of crops in a country regardless of their nutrient content (Food Systems Dashboard 2020). In terms of the diversity of agricultural production, Cambodia (0.72), Myanmar (0.78), and the Philippines (0.86) are providing relatively diverse food commodities in the national food environments.

The three-year average (2015-2017) of the available dietary energy in the food supply of Cambodia (2,463 kilocalories/person/day), Myanmar (2,701 kilocalories/person/day), and the Philippines (2,638 kilocalories/person/day) is sufficient to meet the 2,000 to 2,500 kcal/day recommended amount for healthy adults. About 49% of the population's dietary energy in Myanmar, 58% in the Philippines, and 69% in Cambodia are derived from cereals, roots, and tubers, indicating the diets' lower nutritional quality (FAO 2020).

In terms of adequacy, the available dietary energy in the country's food supply and the supply of protein sources of animal origin (eggs, fish, and flesh-meat) is sufficient to meet

individual recommendations. The protein supply in Cambodia (64.3 grams/person/day), Myanmar (91.7 grams/person/day), and the Philippines (60.3 grams/person/day) are enough to cover the recommended protein intake for healthy adults of (50 to 60 grams/person/day). About 18% (Cambodia), 43% (Myanmar), and 41% (Philippines) of this protein supply come from animal origin (FAO 2020).

Table 13 presents the food supply quantity and adequacy for key commodities. The food supply quantity includes production and imports, and less of the exports and changes in stocks; this considers the food commodity and processed foods derived from it. For the food supply adequacy, the recommended intake values used for fruits (250 g/day), vegetables (360 g/day), legumes/ pulses (60 g/day), and milk (435 g/ day) were derived from the Global Burden of Disease (GBD) 2016 Risk Factors Collaborators, 2017.

The Philippines' supply of fruit meets 118% of the recommended intake, but Cambodia and Myanmar only meets 25% and 51% respectively. The three countries' food supply for milk, pulses, and vegetables falls below the recommended intake per person.

Table 13. Per capita supply of key food commodities (2015-2017)

	Cambodia		Myanmar		Philippines	
	Food supply quantity	Adequacy	Food supply quantity	Adequacy	Food supply quantity	Adequacy
	g/capita/day	%	g/capita/day	%	g/capita/day	%
Eggs	3.6		14.5		10.5	
Fish	115.2		129.4		79.1	
Meat	34.0		155.2		99.9	
Milk	7.3	2	116.3	27	3.3	1
Pulses	13.2	22	37.8	63	3.3	6
Fruit	63.2	25	127.1	51	295.1	118
Vegetables	84.2	23	231.1	64	172.4	48

Source: FAO 2021d

1.3.2 Food affordability

The cost of a Nutrient Adequate Diet or Cost of Nutrient Adequacy (CoNA), is defined as "the lowest-cost set of items available at each time and place that would stay within lower and upper bounds for dietary energy and all essential nutrients" (Food Systems Dashboard 2020). The Nutrient Adequate Diet that meets the dietary energy and all essential nutrients of an individual would consume 74% of the household budget in Cambodia, 60% in

Myanmar, and 40% in the Philippines. The ability of low-income households to avail adequate diet is strongly challenged by its high cost.

Table 14 shows the relative caloric price (RCP) of some food commodities, which refers to the ratio of the price of one calorie of food commodity to the price of one calorie of a representative basket of starchy staple food in a country. The relative caloric price of nutrient-dense food (Vitamin A-rich fruits and vegetables and green leafy vegetables) is costly for low-income households in the three countries. Pulses are generally cheap while fish is expensive in Cambodia and Myanmar. Salty snacks and fats and oils, which could lead to poor nutrition and health outcomes when taken in excessed amounts, are also cheap in these countries.

Table 14. Relative caloric price of food commodity

	Cambodia		Myanmar		Philippines	
Food commodity	RCP ratio	Interpretation	RCP ratio	Interpretation	RCP ratio	Interpretation
Eggs	10.8	Very expensive	9.1	Very expensive	4.4	Expensive
Fish	7.2	Expensive	5.4	Expensive	2.1	Cheap
Milk	10.8	Very expensive	8.8	Very expensive	4.4	Expensive
White meat	9.4	Very expensive	8.9	Very expensive	4.1	Expensive
Pulses	2.3	Cheap	1.4	Very cheap	2.4	Cheap
Vitamin A-rich fruits	16.3	Very expensive	9.2	Very expensive	7.2	Expensive
Vitamin A-rich vegetables	17.3	Very expensive	14.9	Very expensive	14.4	Very expensive
Green leafy vegetables	21.2	Very expensive	15.1	Very expensive	15.7	Very expensive
Fats and oils	1.1	Very cheap	0.9	Very cheap	0.6	Very cheap
Salty snacks	3.8	Cheap	4.3	Expensive	1.6	Very cheap
Soft drinks	12.1	Very expensive	11.3	Very expensive	3.1	Cheap

Source: Food Systems Dashboard 2020

1.3.3 Product properties

Both packaged food and ultra-processed food have become popular in low-middle income countries. Packaged food is defined as any food sold in protective barrier such as plastic, canned, or paper. Ultra-processed foods are defined as foods made of mostly industrial ingredients and additives with minimal amounts of unprocessed foods, are typically energy-dense, are often high in added salt, sugars, and fat. Unless they are fortified, they typically have limited nutritional value beyond calories (Food Systems Dashboard 2020).

The sales per capita of the retail value of sales of packaged food is high, specifically in the Philippines ($110.48), compared with Cambodia ($48.0) and Myanmar ($34.0), and the weighted average for all low-middle income countries ($71.0). The case is similar for sales per capita of the retail value of ultra-processed food, with the Philippines ($104.6) recording higher than Myanmar ($24.0) and Cambodia ($41.0), and the average for low-middle income countries ($39.0) (Food Systems Dashboard 2020).

While packaged and ultra-processed foods have longer shelf-life, are convenient, pose less food safety concerns, and enhance availability and access of specific food items that are relatively unavailable or seasonal in a particular area, many of them are also energy-dense and high in added sugar, salt, and fats, which are detrimental to the health.

1.3.4 Vendor properties

Informal market outlets are the primary food sources in low-middle income countries. However, between 2013 and 2018, Cambodia (114%) and Myanmar (248%) have experienced a significant increase in supermarkets; the Philippines is lower with only 34% change. Consequently, the Philippines have more supermarkets per 100 000 population in 2018 at 2,054, which is four times the number in Cambodia (508) and Myanmar (404) (Food Systems Dashboard 2020). Supermarkets are "retail outlets selling groceries with a selling space of between 400 and 2,500 square meters; excludes discounters, convenience stores and independent grocery stores" (Food Systems Dashboard 2020). The emergence of supermarkets increases the consumers' physical access to diverse food commodities, including processed goods and creates new opportunities and competition for local farmers and traditional retailers.

1.3.5 Food messaging

Cambodia and the Philippines have food-based dietary guidelines for the general healthy population. Meanwhile, Myanmar has policies aiming to protect children from the marketing of junk foods. Both dietary guidelines and food messaging platforms or initiatives serve as general guides for the population in making food choices and as part of the government's public health nutrition programs.

1.4. Individual factors

Household income influences economic access to food and the quality of diets. As income grows, households either diversify their diets or shift expenditure to non-food purchases. For low-income households, purchases and consumption are limited to staples and cheaper food alternatives such as processed food.

Based on the available data for the Philippines, the median income per person per day is at $3.9, 2011 PPP, which is lower than the weighted average for low- middle-income countries ($5.2, 2011 PPP) (World Bank 2019k). With smaller income, individuals and households spend a more significant proportion of their paycheck on diets of less diversity and nutritional quality than those with more disposable income.

The household final consumption expenditure is the market value of all purchased goods and services, including durable products (such as home computers, washing machines, and cars). In 2018, the household final consumption expenditure for Cambodia ($2,485, 2011 PPP), Myanmar ($1,680, 2011 PPP), and the Philippines ($5,364, 2011 PPP) is relatively lower than the average for countries in Southeast Asia ($6,183, 2011 PPP) (World Bank 2019k; Food Systems Dashboard 2020). Although there has been an increase in household final consumption expenditure in these countries, the consumer spending power remains low, which may influence the household's perceived affordability of foods and consumer behaviour.

About 46.2% of household expenditure in Cambodia and 47.0% in the Philippines is spent on food and beverages. Among the poorer households or those living under $2.97 per capita per day or the lowest consumption segment, the value is even higher at 56.8% (Cambodia) and 60.3% (Philippines) (World Bank 2019k; Food Systems Dashboard 2020). These low-income households with higher food expenditure are the most vulnerable to price or income

shocks. Also, they are most likely to have poor quality diets and may shift to cheaper sources of calories when experienced shocks. In both countries, only small proportions of the households devote their food budgets to meat and fish and even lesser on fruits and vegetables. These nutrient-dense food commodities are higher priced relative to starchy staples for low-income households.

1.5. Consumer behaviour

Access to and time to collect basic drinking water and clean cooking facilities improve the ability and time required for food preparation. These are also proxy indicators related to factors influencing the process from acquiring to consuming food. Consumer behaviour covers "all the choices and decisions made by consumers, at the household or individual level, on what food to acquire, store, prepare, cook and eat, and on the allocation of food within the household (including gender repartition and feeding of children)" (HLPE, 2017).

Both access and usage of safely managed drinking services and improved cooking facilities have significantly improved, positively influencing food preparation and consumer choices. The majority of the population has access to basic drinking water services in Cambodia (76.9%), Myanmar (80.3%) and the Philippines (93.1%) (World Bank 2017). On the other hand, access to clean cooking fuels and technologies remains low in Cambodia (17.7%) and Myanmar (18.4%) and only covers almost half in the Philippines (43.2%) (World Bank 2016).

1.6. Dietary intakes

The food system's failure to make nutrient-dense non-staple foods available and affordable in the national food environment shows the general population's diet. The adequacy of adult estimated intake of key food groups was compared to the recommended amount for whole grains (125.0 g/day); vegetable (360.0 g/day); fruit (250.0 g/day); milk (435.0 g/day); legumes (60.0 g/day); nuts and seeds (20.5 g/day); sugar-sweetened beverages (2.5 g/day); sodium (2.0 g/day); processed meat (2.0 g/day); and red meat (22.5 g/day) (GBD 2016 Risk Factors Collaborators 2017).

Most adults do not consume enough whole grains, vegetables, fruits, milk, nuts, and seeds. In Myanmar, adults has consumed a higher amount of legumes (141.6%) while Filipino adults eat an adequate amount of processed meat (100%) and red meat (96%), lower in two other

countries. Simultaneously, the population exceeds the allowable amount for sugar-sweetened beverages, sodium, and processed meat.

Table 15. Adult estimated dietary intake of recommended food groups

Food groups	Cambodia		Myanmar		Philippines	
	Adult estimated dietary intake	Adequacy of recent intake estimates	Adult estimated dietary intake	Adequacy of recent intake estimates	Adult estimated dietary intake	Adequacy of recent intake estimates
	g/day	%	g/day	%	g/day	%
Whole grains	70.9	57	49.7	40	51.9	42
Vegetable	74.8	21	163.9	46	132.7	37
Fruit	39.0	16	54.2	22	143.4	5
Milk	4.4	1	23.3	5	8.5	2
Legumes	45.5	76	84.9	142	11.6	19
Nuts and seeds	2.9	14	5.4	26	1.9	9
Red meat	12.4	55	14.2	63	21.7	96
Sugar-sweetened beverages	13.1	524	18.9	755	63.1	2524
Sodium	4.3	215	4.4	220	4.5	225
Processed meat	0.4	20	0.5	25	2.0	100

Source: IHME 2017; Food Systems Dashboard 2020; Kennedy et al. 2020

1.7. Nutrition and health

Nutrition and health outcomes determine the efficiency of the food system to deliver physically and economically accessible, healthy and sustainable diets for all. However, Cambodia, Myanmar and the Philippines have been continuously challenged by the double burden of malnutrition.

Stunting in children under five remains a significant public health problem in Cambodia (32.4%), Myanmar (29.4%), and the Philippines (32.4%). Iron-deficiency anaemia affects a significant number of young children and women of reproductive age in these countries. While there has been an observed decline in thinness among children and adolescents, 5 to 19 years old, and underweight among adults, overweight and obesity have been on the rise

in all age groups (children under-5, children and adolescents 5-19 years old and adults). Moreover, the prevalence of diet-related diseases among adults has been rising.

Table 16. Nutrition and health outcomes

	Cambodia	Myanmar	Philippines
Children under-five age years old, latest data			
Prevalence of stunting, %	32.4	29.4	30.3
Prevalence of wasting, %	9.7	6.6	5.6
Prevalence of overweight, %	2.2	1.5	4.0
Anaemia, latest estimates			
Prevalence of anemia among children under-5, %	54.4	52.9	17.5
Prevalence of anaemia among women of reproductive age, %	46.8	46.3	15.7
Children and adolescents, 5 to 19 years old, latest estimates			
Prevalence of thinness, %	10.9	12.9	9.9
Prevalence of overweight and obesity, %	11.3	11.6	12.8
Adults, latest estimates			
Prevalence of underweight, %	13.6	14.6	12.3
Prevalence of overweight and obesity, %	20.3	24.6	26.1
Prevalence of diet-related risk factors to non-communicable diseases, latest data			
Adult raised blood pressure, %	25.6	24.5	22.6
Raised blood glucose, %	6.9	7.1	7.2
Raised cholesterol, %	29.5	30.5	43.0

Source: UNICEF/WHO/World Bank 2020; WHO 2017; NCD Risc 2017

1.8. Food insecurity and undernourishment

While Cambodia, Myanmar, and the Philippines have experienced continuous growth in GDP and a decline in poverty rates that indicate economic progress, nearly a third of their populations suffer from extreme malnutrition and food insecurity.

From 2017-2019, about 15% of individuals consumed insufficient calories to cover the energy requirement for an active and healthy life. Moreover, Myanmar's level of undernourishment has remained in the past five years. On the other hand, about half of the population in Cambodia and the Philippines were living in households classified as moderately or severely food insecure or experienced reduced food intake and consumed low-quality diets due to lack of resources.

Table 17. Prevalence of undernourishment and food insecurity

	Cambodia	Myanmar	Philippines
Prevalence of undernourishment (2017-19), %	14.5	14.1	14.5
Prevalence of moderately or severely food insecure (2017-19), %	44.1	No data	59

Source: FAO 2020

PART 2. Local food system

Chhouk Village in Cambodia, Htee Pu Village in Myanmar, and Himbubulo Weste Village in the Philippines are CSVs. A CSV provides a platform for testing, developing, and scaling up location-specific climate risk-management strategies. The process, which involved the farming communities, local governments, and local research community, includes establishing the necessary evidence base through participatory and collaborative approaches and associated action research.

Chhouk, Htee Pu and Himbubulo Weste have rural and traditional food systems and unique biophysical features that command the farming system employed and the primary food commodities produced. There is no distinct role in the local food system. For instance, farmers could also transport, distribute, and sell their produce in the market. An intermediary or middle-person for a crop commodity could be a livestock grower selling meat when needs arise. The local food system provides informal employment opportunities along the food value chain. This work category includes seasonal agriculture and a wide range of low wage, daily-basis, or output-based jobs, including farm labourers, retailers, and drivers.

Table 18 presents the key characteristics of the components in the rural and traditional local food system.

Table 18.Descriptions of local food system operations

	Rural and traditional food system
Food production	Smallholders mainly do farming. In the food supply chains, limited economic access to input supply and landlessness influence the production system. The village's local food production is insufficient to meet all populations' needs. Importation is needed to cover 60 to 70% of the demand for commodities other than those produced in the area. The three villages are climate-smart villages where most farmers have adopted climate-smart agriculture practices to increase agricultural productivity sustainably and reduce farmers' exposure to shocks and risks while building their resilience and capacity to adapt to short- or long-term stresses. By adapting CSA strategies, farmers have a more diverse production through the local farming systems and homesteads. The increased productivity through the combination of crops and livestock results in better household income.
Storage and distribution	The role of mediators or middle persons in the local food system is vital to bring the farmer's produce to the contact markets and provide credit when needed. Other products that the middle persons left made their way to informal points of sale. The distance of the village to the market, and the poor road network, which becomes impassable during heavy rains, are among the commonly cited characteristics of the distribution transport infrastructure. Cold storage is generally absent in the villages.
Retail and markets	The population is dependent on informal and fragmented markets and small retail stores for food supply. Food is mainly sold in informal market outlets, including independently-owned small shops, street vendors, and local public markets. There are reported lean seasons in these villages.
Food environment (availability and affordability)	Starchy staples are highly available; the quantity, diversity and prices of foods available are season-dependent Processed and package foods start to emerge in retail stores
Diets	In general, household diets are inadequate and lack diversity from food groups such as meat, dairy products, fruits, nuts, and seeds.

The rural and traditional food system typology of agriculture-based villages appears resilient due to the relatively short and stable food supply chain. However, it offers less diverse food choices. Figure 5 shows the components that describe the food system operations and hotspots or concerns identified by the food system actors.

- Among the food system drivers, the environment and climate and climate change have the most negative perceived impact.
- In the food supply chain, increasing landlessness and limited economic access to input supply directly influence the production system and interlinked with overall productivity

and income. CSA practices in the three CSVs have fostered more resilient local food systems.

- The inefficiency caused by the general lack of road infrastructure hampers import and export of food commodities and creates bottlenecks in the food supply. The role of middle persons in the food supply chain is essential.
- The population depends on various food sources, primarily informal markets that offer cheaper products in retail. Distance to these markets, however, is an issue.
- The perceived availability and cost of food commodities differ from each community and among food system actors. The informal exchange of food, foraging of wild food and own production, or homestead gardens is vital, especially in rural and traditional food systems.
- Economic access to food is considered an issue among the actors of the food system.
- Limited access to electricity, drinking water, and cooking fuels negatively influences cooking time and consumption.
- The population's diets are inadequate in quantity and less diverse.
- The perceived food insecurity and nutritional status are food system outcomes that have not improved compared to a decade ago.

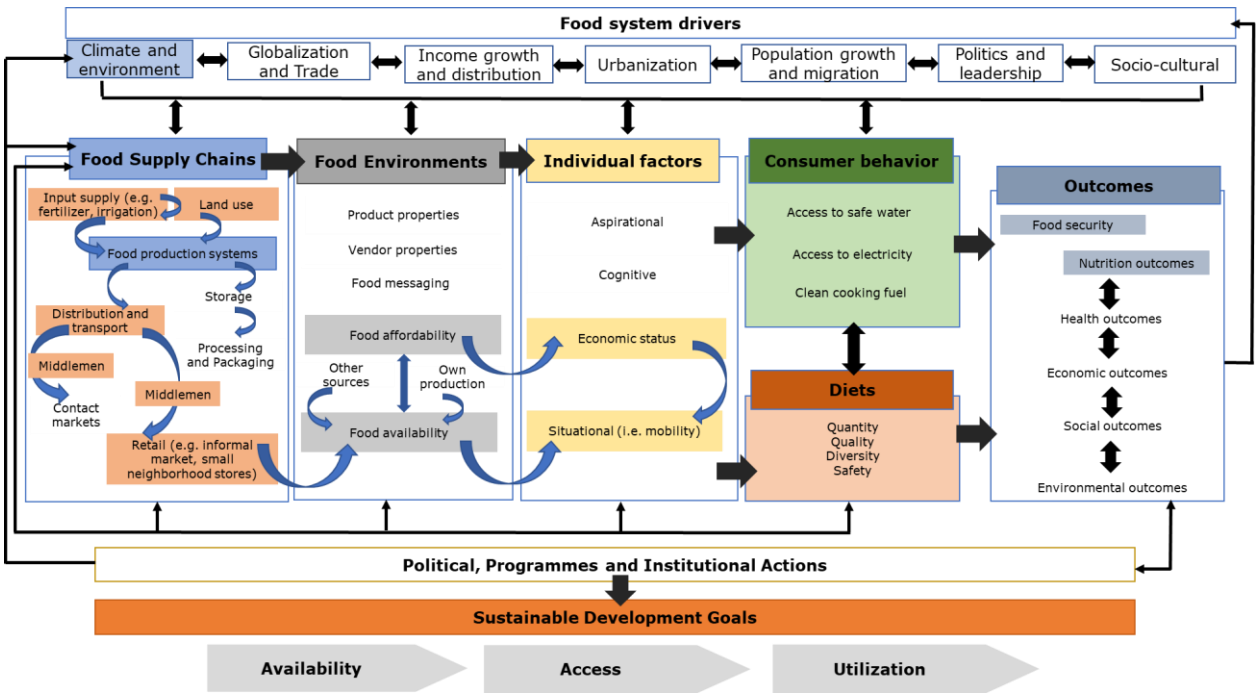

Figure 5. Conceptual framework of the local food system of Chhouk Village, Htee Pu Village and Himbubulo Weste Village (Source: adapted from HLPE 2017)

2.1. Perceived impact of climate change on the local food system

Chhouk Village is found in Chi Kha Leu Commune in Srae Ambel District, Province of Koh Kong. Srae Ambel consists mainly of ecological water systems, cropland, mangroves, and grassland. Chhouk Village, specifically, has a coastal agroecosystem. Rice farming, under saline condition, is the primary source of livelihood of the population. Farmers plant according to season. They plant in the low land during the dry season and in the upland during the rainy season. Seasonal rice farmers are engaged in raising local chickens and off-season crops. Others are foraging valuable products from the forest such as cashew nuts and common fruits or eels from water resources.

Box 1. Climate condition in Chhouk village (Weather Spark 2016)

In Srae Ambel, the wet season is hot and overcast. The dry season is warm and partly cloudy. The mean annual temperature ranges from 72°F to 90°F and is rarely below 67°F or above 95°F. In terms of temperature, the hot season is between March and June, while the cold season is between December and February.

The chance of wet days in Srae Ambel varies very significantly throughout the year. The wetter season lasts for about 6 months (April to November), with a greater than 43% chance of a given day being a wet day. The drier season lasts for about 6 months (November to April).

Rain falls throughout the year in Srae Ambel, with extreme seasonal variation in monthly rainfall. The most rain falls during a 31-day period centred around August, with an average total accumulation of 19.1 inches. The least rain falls around January with an average total accumulation of 0.7 inches.

Htee Pu Village is a highly rural community in one of the village tracts of Nyaung-Oo Township in Mandalay State, a region in the central dry zone of Myanmar. It lies on the eastern bank of Ayeyawady River. Nyaung-Oo Township has a typical tropical climate, relatively hot and dry throughout the year. It receives little rain, leading to drought in the majority of its areas. Nyaung-Oo is one of the townships in the dry zone and home to the poorest and a densely populated Myanmar region. Htee Pu Village has a dry semi-arid agroecosystem suitable for rice, cotton, peanut, sesame, and legumes. The primary source of livelihood is the farming of cash crops, mainly peanut or groundnut and pigeon pea, intercropped with various types of beans, millet, and sorghum. Tomato and tamarind are

also important crops. Others are involved in raising chicken in the backyard as a sole income source or in combination with crop production. Some households are involved in agroforestry. Livestock is considered important household assets and usually sold during high vulnerability periods such as crop failure. The majority of the households, especially the more impoverished farmers, owns goats while others have cattle as farm help.

Box 2. Climate condition in Htee Pu village (JICA 2013)

Myanmar has a tropical to subtropical monsoon climate with three seasons: the rainy season (mid-May to mid-October), winter (mid-October to mid-February) and summer (mid-February to mid-May). In Nyaung-Oo Township, the precipitation is highest in October and lowest from December-April.

The average monthly temperature, based on the township-level temperature recorded data, ranges from 19°C to 39°C within a year (data between 2006 to 2017). The hottest months were April and May, and the coldest was from December to February. Based on various climate observations in Nyaung-Oo Township from 2006 to 2016, the minimum and maximum temperature fluctuations were getting extreme.

Meanwhile, the average annual rainfall in Nyaung-Oo Township from 2007 to 2016 was 679 mm/year, with the highest total precipitation at 1,024 mm in 2011 and the lowest total precipitation at 343 mm in 2009, which was the year of drought. Drought is reported to occur once every two years.

Himbubulo Weste Village is one of the rural villages of Guinayangan, a third-class municipality in the southeastern part of Quezon Province, Philippines. It is one of the upland villages, which are generally hilly and mountainous. Himbubulo Weste occupies a portion of the province's protected watershed, Maulawin Spring Protected Landscape, contributing to the municipality's biodiversity, climate, and livelihood activities. Himbubulo Weste has upland coconut-based agroecology. Most of the residents are smallholder farmers engaged in coconut farming with copra (desiccated coconut) as the village's top product and corn as the second main crop. High-value crops used as intercrops of coconuts are coffee, cacao, banana, mango, pineapple, and vegetables (i.e., Chinese white cabbage, string beans and bitter gourd). Some farming households are engaged in hog raising and poultry production, while others are tenants or labourers in coconut farms.

Box 3. Climate condition in Himbubulo Weste (GLGU 2017)

Based on the municipal-level data, the mean annual temperature in Guinayangan is at 26.8°C, ranging from 21.9ºC (January and February) to 32.8°C (May and June). The mean annual relative humidity is 83%, with a minimum of 81% in April and May and 85% in November to February. Rainfall depths range from 114.1 mm (month of May) to 636.6 mm (month of December), with October to December having a heavy rainfall of greater than 250 mm.

Himbubulo Weste and most municipality areas are under the Type IV climate category, whereby rainfall is more or less. Overall, the village is at its warmest from March to May and coolest from December to January. The dry months are from February to August. During this period, the village experiences very little or no rainfall at all, and the sources of water for domestic use are affected by drought. Conversely, the wet months are from September to January.

At the village level, among the factors that influence the local food system, those related to climate are most felt by the residents and considered detrimental to their livelihoods and general way of living. Climate change was evidenced by warmer temperature and higher incidences of drought. Simultaneously, heavy rainfall during wet seasons often leads to flooding.

Table 19. Perceived climate change in the village level

	Chhouk Village	Htee Pu Village	Himbubulo Weste Village
Perceived climatic changes	Warmer temperature Droughts or lesser water in the dry season Flooding in wet seasons	Irregular rain patterns Lesser amount of rainfall	Too much heat or high-temperature Typhoons with heavy rainfall
	"…there is a need to adapt to drought and increase in temperature experienced in the past years" (Farmer).	"High temperature and drought affect the livelihood; because of lesser amount of rainfall, there is lesser available water for farm use" (Farmer).	"Heavy rainfall results in flooding that damage the crops, agricultural land, other inputs, and farming activities in general" (Farmer).

2.2 Land ownership, input supply, and CSA practices

Land ownership and economic access to input supply are critical issues in the local food systems of three villages. Smallholder farmers are the primary food producers in the local food system. In terms of landholding, farmers in the three CSVs have different means of acquiring the land.

Table 20. Land acquisition in the three villages

CSV	Means of land acquisition
Chhouk Village	Farming households have smaller farmland for food production and not enough to gain higher profit (**FGD**). In Chhouk Village, 54.3% of total rice farming households (184 households) own rice land less than 1 ha, and 37.6% of total farming families (85 households) owns less than 1 ha Chamkar land. These farmers may cultivate more than 1 ha of crop field on rental land. (Royal Government of Cambodia 2010)
Htee Pu Village	The average landholding in the village is 2 acres. Landlessness in the village has been increasing over the past years, and households turn into farm labour. "Land for food production is accessed as ancestral land or borrowed land" (**FGD**) The land tenure systems are in transition from communal and ancestral ownership to privately owned land and the increased recognition of user rights. Farmers run a risk of land dispossession since shifting cultivation areas are not entitled to formal tenurial security. Under the 2012 Vacant Fallow and Virgin Lands (VFVL) Management Law, only permanent farmland can be issued land-use certificates. Based on the Farmland Act (2012), land can be legally bought and sold with land titles (Barbon et al. 2017)
Himbubulo Weste Village	In Himbubulo Weste, those involved in farming are primarily tenants. Households occupying the multiple-use zone of the MSPL (multi-purpose agroforestry in support of food production and livelihoods) have been awarded a 25-year tenurial instrument for utilizing the land while maintaining and protecting the watershed. This approach is giving importance to community involvement in managing the forest called Protected Areas Community Based Management Agreement (GLGU 2017).

At the village level, there is an uneven distribution and access to production. Moreover, Farmers purchase quality seeds and fertilizers out of pocket, although government and nonprofit organizations provide some assistance. Market access is competitive, and transportation and input cost are high.

Furthermore, irrigation is a major challenge that farmers face amidst the worsening impacts of drought. The production system in the three CSVs is rain-dependent for irrigation. When

available, other methods are irrigation from a canal or dam, natural source (river, stream, lake, and natural pond), drilled well, and dug pond.

In the commune that covers Chhouk CSV, 100% (910 ha) are wet-season rain-fed rice land or irrigated area compare to the total actual rice cultivation area. Other irrigation methods are irrigation from canals or dams, natural sources (river, stream, lake, and natural pond), drilled wells, and dug pond (Royal Government of Cambodia 2010).

In Htee Pu village, the number of embarkment (a raised structure used primarily to hold back water) covers 12 ha in total. Five river pumps cover 6,671 ha of total land area (TGAD 2019).

Out of the total production area of the municipality that covers Himbubulo Weste CSV, 80% is rainfed, 16% irrigated, and the remaining 4% is located in the upland. There are eight barangays with irrigation facilities having a combined service area of 110 hectares benefitting around 200 farmers. The types of irrigation system are pump and gravity (GLGU 2017).

The role of CSA practices

CSA practices can address limited access to fertilizer, drought issues, and lower agricultural productivity, among other challenges. They can increase agricultural productivity sustainably and reduce the farmers' exposure to shocks and risks while building their resilience and capacity to adapt to short- or long-term stresses. Diversification and intensification are critical elements in implementing CSA.

The farmers have been utilizing these practices already in the CSVs. The International Institute of Rural Reconstruction (IIRR) has been working with farmers in Chhouk CSV, Htee Pu CSV, and Himbubulo Weste CSV in promoting CSA strategies for climate adaptation and mitigation. As each community has a unique agro-ecological landscape, the engagements have been centred on indigenous knowledge and community-driven approaches.

In Chhouk CSV, households are engaged in two food production subsystems: homesteads and traditional farming system. Homestead areas range from half to one hectare, where a combination of crops and other food commodities for domestic consumption and market utilization are grown. These could include fruit trees, spices and vegetables, and small livestock (native chicken production). Homesteads also cater to small livestock production.

Due to the availability of inputs, mostly local chicks, from IIRR projects, native chicken production has increased in the village.

Small native chicken production is a high-value commodity for smallholders that make broilers, eggs, and chick more available to meet household needs for animal-sourced protein and alternative income sources. Aside from providing economic benefits and a diverse food source, homestead spaces are also an avenue of climate-smart strategies. The use of crop residues and organic waste as compost or as mulch helps maintain soil moisture and reduce soil temperature, which is significant during dry seasons. Minimizing the use of chemicals lead to better soil quality and higher yields. In response to irrigation issues, farmers adapted drip irrigation, where water is placed directly into the root zone to minimize evaporation. The practice of drip irrigation means lesser water usage and less human labour.

Figure 6. Homestead garden with fish pond (left), and small native chicken production (right) in Chhouk village. Source: IIRR Cambodia.

In Htee Pu CSV, farmers have also capitalized on diversification and intensification. IIRR is engaged with the local community through the existing CSA practices such as the production of legumes, intercropping and crop rotation, utilization of organic matter, and raising of small livestock. Livestock is recognized as an important economic asset in the community, especially among low income and landless households. Large animals such as bulls are an emergency asset used as transportation and can be rented as alternative income stream. The raising of native chicken has become popular in the village due to the provision of local

chicks from the IIRR. Aside from economic benefits, livestock also bring the nutritional needs of the households for animal-sourced protein.

Himbubulo Weste is among the upland areas near the watershed that practice monocrop coconut-based system. The dependence on coconut production put farmers at risk as coconuts are vulnerable to calamities and need long periods to recover. However, coconut and its extensive coverage in the area serve as effective carbon sinks. Through the combined work on climate-smart/climate-resilient agriculture of the IIRR and the Municipal Agriculturist Office and as supported by Forest Foundation Philippines, diversification and intensification through agroforestry have been introduced. Agroforestry in upland ecosystems offers farmers and low-income households several opportunities to benefit from using CSA interventions, achieving both income alternatives and mitigation and adaptation objectives.

Commercially relevant fruit trees and cash crops such as cacao, coffee, rambutan, soursop, and banana were introduced to farmers and are intercropped with a coconut-based system. Fruit trees have several benefits. The mother fruit trees ensure the future sources of good quality seedlings and vegetative propagation materials. They also provide sources of nutritious commodity and income when sold in the local market. The technique of the deep pit planting of fruit trees ensures the development of a deep root structure that can cope with drought and typhoons when their roots become uprooted. However, since fruits trees take about five years to bear fruits, farmers have to wait to reap the harvest.

Small native pig production was also introduced in Himbubulo Weste. The farmers practise small-scale, backyard systems that use CSA interventions such as building native housing for animals (bamboo poles) and relying on locally grown feed sources (roots and tubers, leafy crops), and using alternatives (copra and rice bran). Economically, small livestock provides farmers with additional income or emergency funds. This can also be a source of animal-based protein for the households and community on special occasions. Local feeds reduce expenses from commercial and expensive feeds and transport cost to buy them. Likewise, the use of lightweight and natural animal housing materials decreases their expenses.

Roots and tubers are drought-resistant crops, are less susceptible to extreme winds as they grow below the ground and in diverse environments. A cassava-based CSA practice provides

farmers with an alternative income source when coconut harvests are low and potentially higher income from processed and value-added products from cassava. The harvests are mainly for household consumption, feed for livestock, and local market retail. IIRR supports and promotes local production of yellow, orange, red and violet sweet potato for its nutrition profile and cassava for its value addition through processing.

Figure 7. Local farmers in Himbubulo Weste selling their roots and tuber harvest. Source: IIRR Philippines.

Overall, by adapting CSA strategies including their local farming systems and homesteads, farmers have a more diverse diet from having varied production. The increased productivity through the combination of crops and livestock results in better household income. When combined with diverse cropping, homesteads are more resilient to climate variability and extreme weather events. Also, the short food systems supplying to local markets have a low carbon footprint in general.

2.3 Distribution and transport

Poor and underdeveloped distribution infrastructure affects the livelihood and general activities in the local food system while delaying potential improvements in the food value chain. Without a cold chain and processing facilities to store and transport food commodities and with a poor road network impassable on heavy rainfall, the local food system cannot produce for the high-end market. For the farmers and in the middle of the food supply chain, the warmer temperature would lead to more food losses due to spoilage in the absence of cold storage facilities.

As the food supply chain is short, processing and packaging do not generally provide livelihoods in the local food system. The smallholder farmers and the informal traders are challenged by the absence of a stable contact market, inadequate storage, distribution and transport infrastructure, and poor economic status. The role of middle persons is critical in the local food system as they connect the farmers to the market and bring the products to sales point for the consumers. In general, buyers have high market power over the farmers to demand cheaper products given the distribution challenge.

In the case of Chhouk Village, in 2009, the Chi Kha Leu Commune had a total road length of 20.97 kilometres, 74% of which is concrete and laterite road; 11% constructed earth road; and 14% as unconstructed earth road (Royal Government of Cambodia 2010).

Food producers

- The distance of the main road to the village
- Impassable roads, especially during heavy rainfall
- The selling price is usually low while raw materials are expensive.
- While storage and processing facilities are limited, food losses are maintained low to keep the income losses.

Retailers and distributors

- Impassable road during heavy rain
- Far markets
- Low selling price leading to less income
- When production or purchasing is in bulk, products are sold at a lower price; otherwise, products can be sold at a high price.
- The warm temperature has an impact and lack of knowledge in storage and distribution
- Food loss and waste translate to a loss in income and thus are minimized; in the case of food waste, these are used as animal feeds.

Box 4. Challenges or barriers in distribution and transport, Chhouk Village

Figure 82. Means of transport in rural villages in Myanmar, by foot (left) and using bicycle (right). Source: IIRR Myanmar.

In the case of Htee Pu Village, country-wide, 60% of highways and most rail lines are in poor condition. Moreover, 20 million people do not have access to primary roads (Ministry of Construction 2018).

Box 5. Challenges or barriers in distribution and transport, Htee Pu

Food producers

- Food producers sell their produce through local operators or middle persons or direct retail marketing outlets.
- The middle persons in the food supply chain act as market linkage.
- Food losses and waste are generated throughout the area's value chain, mainly in farms or production areas.
- The waste from the death of livestock such as goat and chicken due to disease problem is difficult to handle.

Retailers and distributors

- Retailers buy wholesale from the nearby market and sell to the village using a motorbike.
- Middle persons play a crucial role in supply and distribution.
- Improved and more connected roads are essential for supply and distribution; however, these are lacking in the village. The warm temperature has an impact and lack of knowledge in storage and distribution
- Food loss and waste translate to a loss in income, thus are minimized; in the case of food waste, these are used as animal feeds.

In the case of Himbubulo Weste, the total length of roads, mainly concrete-type in Guinayangan, is 113.04 kilometres (2015), with 70% expanding to villages. Most of these village roads are considered farm-to-market roads. The majority of the road pavement is made of earth/dirt-filled materials (59%), making most of the villages, especially the outlying areas, impassable during rainy days (GLGU 2017).

Box 6. Challenges or barriers in distribution and transport, Himbubulo Weste

Food producers

- For the livestock growers, intermediaries facilitate the selling.
- Some have contracts with modern grocery retailers or supermarkets and some private establishments.
- Vegetable farmers sell in small amounts or retail—often through middle persons.
- As the road is not concrete, transportation and movement of any supply are hampered, especially during typhoon season, as some areas are impassable. The most convenient form of transport is the makeshift motor vehicle capable of carrying heavy loads and several people, yet small enough to pass the underdeveloped road.
- Storage and processing facilities are generally lacking in the village.
- Some farmers rent a bigger vehicle to deliver the harvest for selling to the public market.

Retailers and distributors

- Those in the distribution and transportation industries mediate between the farmers and the consumers.
- They do direct wholesale marketing and bring the product to the market or any points of sale.
- Others offer credit, especially for frozen products.
- Hawkers by foot or by food cart are common.
- Due to damage during transport, unacceptable items are sold at lower prices or used for fertilizer; other items are utilized as feeds for pigs.
- The road is not concrete. There is a need to use an alternative makeshift motor vehicle that affects the product's quality during travel. Also, the fare is expensive.

In the event of power interruption, perishables get spoiled easily, so other consumers pay for lower prices.

2.4 Salespoint and mobility

Households in the three villages share similarities in the varied sources of food. Homestead gardens, whether owned or communal, supply the local vegetables. A few have fruit trees that provide seasonal supply. The small retail stores in the neighbourhood, which often are within 100 to 500 meters from the households, are the primary source for dry goods such as grains, cooking oil, canned goods, and condiments. Other retail stores offer a limited option of perishable goods. Whether by foot or motorcycle, food hawkers sell perishable goods such as meat, fish and vegetables around the community and increases the households' physical access to food.

Informal markets or local government-managed public markets are sales point with large quantity and diverse food supply. Public markets consist of stalls strategically zoned into sections for grains, meat and fish, fruits and vegetables, dry goods, and groceries. Retailers of the same products, often vegetables and fish, are present around the market either with smaller stalls, on pushcarts, the roadside or selling by foot. The distance of the market from the village, mobility of the households, and transportation means are essential determinants of consumption.

Chhouk Village is about 13 kilometres to the nearest public market with a perceived distance of 12 to 20 kilometres. Motorbike is the primary mode of transport around the village. Others ride bicycle and bicycle with trailer, ox-carts and horse-carts, motorbike and motorbike with trailer, and motor tricycle.

Htee Pu Village is about 5 to 13 miles far from two major public markets. Motorcycle/moped is the primary means of mobility; secondary modes of transport are cart, bullock, bicycle, and van.

Himbubulo Weste is about 5 km from the town centre, and the public market is approximately less than two kilometres away from the significant number of households and can be accessed by foot. The makeshift motorbike is the common form of transportation although the fare is expensive. Other modes of transport for people and supplies include private cars, vans, public utility jeepneys, and motorcycles.

Figure 9. An informal market or public wet market in Myanmar. Source: IIRR Myanmar.

2.5 Food environment: availability and affordability of diets

The households' ability to purchase healthy diets depends on their disposable income and the availability and prices of food items relative to other food commodities. In general, primary food groups (rice, fresh vegetables, legumes, egg, meat, and cooking oil) are available through various informal exchanges and production in the village and sales points. Dry goods, including grains, cooking oil, and condiments, are available in the public market and small neighbourhood stores and are typically purchased in retail.

In Chhouk Village, homesteads and traditional farming system produce fruits, spices and vegetables, and at the same time, broilers and eggs from small native chicken production. Aside from income sources, these also meet the households' needs for animal protein. In Htee Pu Village, native vegetables, legumes, native chicken and seasonal animal-source protein from big livestock are available for the households. In Himbubulo Weste Village, households have access to roots and tubers, native vegetables, and fruits. The small native pig production provides farmers with additional income or emergency funds and can also be a source of animal-sourced protein for the households.

The location of the village influences the price and availability of some food commodities. Fish and seafood are generally unaffordable for the households in Chhouk and Htee Pu villages. In contrast, some households in Himbubulo Weste reported that they consuming it because it is accessible from a community engaged in fisheries. Fresh meat such as beef, pork, mutton, chicken is perceived to have increased in price by all actors in the three villages. The high cost of meat, fish, and seafood in relation to the household's income would decrease its consumption; thus, the intake of essential nutrients that these products contain.

Table 21. Perceived changes in the price of key food commodities

Chhouk Village	Perceived increase in price: meat (beef, pork), fish and seafood and all fruit types
Htee Pu Village	Perceived increase in price: rice, oil, meat (beef, mutton), fish and seafood
Himbubulo Weste Village	Perceived increase in price: rice, oil, meat (pork, chicken), egg, vegetables, canned goods, coffee, soft drinks

In recent years, the residents have seen an increase in the availability of imported packaged foods that are more appealing, convenient, and cheaper than fresh produce. This is mainly observed in Himbubulo Weste, whereby imported products, which are commonly canned and processed, are more affordable than the local products.

The majority of the households in the three villages are engaged in several CSA strategies that enabled them to produce diverse food commodities within the local food system. IIRR has been working with local communities to complement production systems such as small native chicken production in homesteads in Chhouk village, intercropping of legumes, and raising native chicken in Htee Pu village, and traditional pig production in agroforestry in Himbubulo Weste. The traditional production system has increased access to local food supplies of vegetables, legumes, root crops, eggs and chicken meat, which are crucial in meeting both the economic and nutrition objectives for vulnerable households.

2.6 Economic status

The local food system provides several livelihoods other than farming. Notably, the economic status of the population has remained poor. In the three villages, the daily wage earners or those involved in works not related to farming reported no improvement in their economic status and income in the past decade. Meanwhile, those involved in the middle of the supply chain experienced minor improvement, and the farming households have the most significant improvement (Table 22).

Table 22. Perceived improvement in the livelihood of actors in the food system

	Chhouk Village	**Htee Pu Village**	**Himbubulo Weste Village**
Farmers	With significant improvements compared to 10 years ago	With improvements compared to 10 years ago	With improvements compared to 10 years ago
Distribution and transport	With minor improvements compared to 10 years ago	With minor improvements compared to 10 years ago	With minor improvements compared to 10 years ago
Farming households	With significant improvements compared to 10 years ago	With improvements compared to 10 years ago	With improvements compared to 10 years ago
Daily wage earners	Worse compared to 10 years ago	Worse compared to 10 years ago	Worse compared to 10 years ago

In Chhouk Village, along with traditional rice farming, cultivating long- and short-term crops, cultivating vegetables, and livestock raising, some residents are foraging other products (i.e., eel, local fruits) to be sold to informal points of sale such as the local market or small retail stores. Others are retail store owners where they buy food commodities from the market in bulk and sell in the village in retail amount. A small proportion is involved in service (trading, repair, transport service, and other services).

The monthly income of labourers, marketers or other jobs in the informal sector is Cambodia Riel (KHR) 5 000 ($1.23) to 250 000 ($61.65). The reported estimated monthly income of farmers, sellers, or doing combined and diverse work in the local food system is KHR 50 000 ($12.33) to 400 000 ($98.63).

In Htee Pu Village, about one-third of the population is engaged in agriculture. Farming of cash crops (peanut, pigeon pea, tomato) is the primary livelihood and income source. Others are involved in raising chicken, cow, and goat as farm help and as subsistence. Some are paid farm labourers or involved in craft and related trades worker. The monthly income is relatively low with some earning Myanmar Kyats (MMK) 70 000 ($49.77) per month.

The reported estimated monthly income of crop farmers is MMK 70 000 ($49.77) to MMK 100 000 ($71.10); those involved in livestock earn MMK 140 000 ($99.54). The mean monthly income of those involved in retail, marketing, distribution and transport is MMK 120 000 ($85.32). Daily wage earners have a mean monthly income of MMK 100 000 ($71.10), with few earning MMK 300 000 ($213.30).

In Himbubulo Weste Village, as copra production requires several steps, the coconut sector employs most villagers in the area. Few households are landowners, and others are tenants or daily wage earners hired as labourers in coconut farms. A relatively small percentage of the farmers are involved in corn production and other crops such as peanuts, root crops, banana and vegetable. Others are involved in selling or transporting produce to selling points. Also, running a retail store or selling in informal neighbourhood markets serves as a household's livelihood and income.

The reported average monthly income of those involved in food production (coconut farmer, vegetable farmer, livestock raiser, and mixed farmer) was Philippine Peso (PHP) 3 500

($72.05) (Range: PHP 1 500 to 15 000 or $30.88 to 308.80). Individuals involved in storage, processing, distribution, and retail (retail store owner, general retailer, online seller, frozen goods dealer, retailer, workers in the farm) had a reported income of PHP 3 000 ($61.76) (Range: PHP 500 to 12 000 or $10.29 to 247.04). Monthly income of farming households was PHP 3 000 ($61.76) (Range: PHP 600 to 15 500 or $12.35 to 319.09); and non-farming households or daily wage earners PHP 2 500 ($51.47) (Range: PHP 700 to 9 000 or $14.41 to 185.28).

2.7 Access to basic services: electricity, safe water source and clean cooking fuel

Another important consideration in the food system is those related to consumer behaviour. Whether the households have access to electricity, safely managed water source and clean cooking fuel influence their consumption decisions and their ability and time required to prepare food.

It is a challenge for consumers to store perishable food items, whether for daily consumption or in preparation for calamity. The warmer temperature and increasing incidence of drought result in a decline in domestic water resources for household and irrigation use. As the population already has a limited clean water source, the frequent drought would exacerbate their way of life and livelihood.

In Chhouk Village, most households depend on battery-sourced for electricity, as most do not have access to electric power and few use candles and kerosene. Clean domestic water remains a challenge as the majority depend on unimproved sources. Wood-related materials are used as cooking fuels.

The majority of the households in Htee Pu Village do not have access to clean drinking water. It is customary to collect rainwater in jars for general household usage. Similarly, most do not have electricity or power supply and rely on kerosene or watermill except for those who own solar panels. Meanwhile, the population is dependent on wood-related materials for cooking fuels.

Similarly, households in Himbubulo Weste do not have access to clean drinking water. A few depend on unsafe domestic water sources such as artesian wells and pump. Electric power is

available in some households, but a few remains without electricity and the population also experiences frequent power interruptions. Firewood or charcoal is the everyday cooking fuel in the village.

2.8 Diets

The population is highly dependent on the crops that the local food system produces. Rice, local vegetables, and cooking oil are the primary parts of the households' diet in the three agriculture-based communities. Chicken eggs are the predominant protein-sourced food in Chhouk Village while legumes are common in Htee Pu Village. Fish and meat are common in Himbubulo Weste. The dietary pattern could be attributed to more farmers adopting native chicken production, increasing access to broilers and eggs. In Himbubulo Weste, aside from the proximity to the coastal community supplying fish, more households are raising native pigs than before, which means access to pig meat becomes more common.

In general, household diets are inadequate in quantity as perceived by the food system actors and lack of diversity from food groups such as meat, dairy products, fruits, nuts, and seeds.

2.9 Perceived food security and nutritional status

As subsistence farmers and unskilled labourers with low economic status, the population experienced a general lack or absence of food for household consumption at one point in their lives. The kind of work provides inadequate and often unpredictable income, making the population more vulnerable to food insecurity and related outcomes. All actors in the local food system in the three villages reported having experienced food insecurity, which has become worse than 10 years ago.

Similarly, when asked about the perceived changes or improvement in the households' nutritional status, all actors in the local food system in the three villages expressed no significant changes compared with 10 years ago.

The three villages are home to the poorest and most food-insecure households facing significant challenges in the local food system. Similarly, these agricultural villages are at the frontlines of climate impacts, which would put livelihood at risk, leading to poverty, undernourishment, and malnutrition.

Conclusion and recommendations

Cambodia, Myanmar and the Philippines are highly vulnerable to climate risks. Over the past years, these countries have experienced stronger typhoons and more pronounced incidences of drought. In fact, among the various food system drivers, climate change has the most perceived impact at the local level, whether among food producers, retailers, distributors, middle-persons, and consuming households in Chhouk, Htee Pu, and Himbubulo Weste. The unique biophysical environment, socio-economic structure and climate-related issues would drive the country's climate adaptation and mitigation strategies. Between mitigation and adaptation, the latter would benefit the low-middle income agriculture-based countries. For agriculture-based communities, modalities through policy, programs, and capacity building must be provided to help farmers and other food system actors adapt to climatic events. Climate adaptation must be embedded in the local management planning while finding means to integrate mitigation in the longer term. While doing so, mitigation strategies should also be part of the national reform to respond to climate change as evidence shows a rise in GHG emissions from agriculture. This is despite the low level of GHG emissions contributed by agriculture from these countries.

The rural and traditional food systems of the three villages must respond to climate change while addressing poverty, undernourishment, and malnutrition in its already poor and food-insecure populations. On the other hand, national policies are needed in both the informal and expanding food system of Myanmar and the Philippines, and the rural and traditional food system of Cambodia, to support the delivery of healthy and sustainable diets.

The three CSVs have long been practising CSA strategies, whether from indigenous knowledge or as supported through the local government and organizations such as IIRR. CSA practices that aim at drought management should be reinforced such as water resources management and rainwater harvesting for irrigation and household use. Farmers in the three villages would benefit from using drought-resistant crops and the diversification of crops that can tolerate the spectrum of conditions, whether warmer and drier or wetter conditions. Actions can also include establishing infrastructure that can withstand extreme weather condition and reduce risk from frequent flooding and heavy rainfall.

By nature, local farming and homestead systems are diverse. To improve the farmers' income and reduce risks to livelihoods caused by climate change, maximizing land-use productivity by simultaneously growing crops and raising livestock is another beneficial practice that farmers reported. Complementation of production systems is observed in the CSVs such as small native chicken production in homesteads in Chhouk CSV, intercropping of legumes and raising native chicken in Htee Pu CSV, and traditional pig production in agroforestry in Himbubulo Weste. The practice of local farming systems and homestead systems and focusing on native and small livestock production can sustainably improve household income and diets. When combined with diverse cropping, homesteads are more resilient to climate variability and extreme weather events. Also, the short food systems supplying to local markets have a low carbon footprint in general.

Another crucial concern in the local food system is the issue related of land ownership. The increasing incidence of landlessness related to land reforms in Htee Pu Village, the small farmland allotment in Chhouk Village, and the tenurial condition of farmers in Himbubulo Weste directly impact land management and general agricultural productivity. Local communities have the knowledge and ability to protect the land and adapt to a changing environment. When local communities have the land rights, they are more likely to protect natural resources and land quality to sustain their livelihoods amidst the threat of climate change and other external drivers.

The distribution and transportation in the local food system are where the different actors share similar challenges. Transportation cost is high and an economic burden for farmers, distributors and consumers. Typically, the consumers carry the cost with higher prices of food items when it reached the informal markets or retail stores. Poor road networks, the relative distance of villages to the main road, and the impassability of main roads during heavy rainfall create bottlenecks in the food supply chains. Food losses during transportation account for a considerable percentage of overall losses in the supply chain. Increased investments on infrastructure, transportation and rural economic development are critical to reduce food loss and waste, ensure safety and nutritional quality of perishable goods, and maximize economic gain for all food system actors.

A unique feature of rural and traditional food systems is the non-monetary exchanges of food commodities and informal markets. The role of varied sources of food commodities and points of sale in the population's diets is critical for low-income households. Among the rural villages' food sources are public or informal wet markets, makeshift markets or hawkers in motorbikes, retail stores in the neighbourhood, and some from their homestead garden and livestock. The majority of the population has easy access to retail stores within 2 kilometres but wet markets that offer a more diverse and fresh selection of food commodities require longer travel time and transportation cost. Moreover, markets are fragmented and unorganized, influencing both the households' economic and physical access to various food commodities. For instance, while hawkers bring fresh products closer to consumers, the price is often marked up.

Electricity, drinking water, and cooking fuels improve the ability and time required for food preparation. However, access is generally limited to low-income households. An inclusive and responsive food system also ensures that basic services are available for the population. The population's diets were also hotspots in the local food system because of low diversity as consumption is limited to what is produced in the area. The link between the various components—from the bottlenecks in the food supply, cost of essential food commodities to poor economic status- is reflected in all the actors' negative perception of food insecurity and nutritional status in the local food system. Establishing social protection packages can sustain vulnerable actors in the food system and ensure economic access to food.

While national-level policies to achieve an equitable and resilient food system are critical, local-level initiatives such as CSA strategies, recognizing landlessness issues and addressing fragmented market infrastructure, are vital for the local food system to thrive and deliver on health, economic, and environmental goals. This could also be the basis to establish standards, collective goals, and policy formulation directions for robust national food systems.

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